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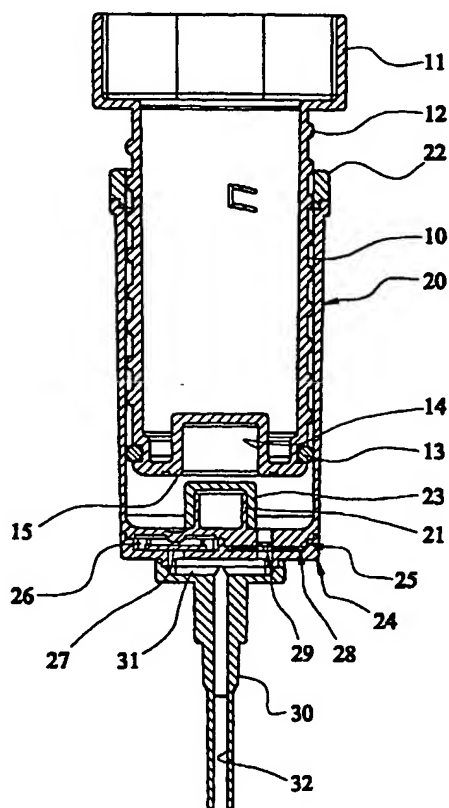
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[Continued on next page]

(54) Title: SAMPLING DEVICE



(57) Abstract: A sampling device comprises a plunger (10) longitudinally displaceable in one direction in a barrel (20) to draw a volume of liquid into the barrel, and then displaceable in the opposite direction to expel the volume of liquid, and also a volume of reagent contained in a compartment (14) of the plunger, through a filter (29). The device may be used to test for the presence of micro-organisms picked up by the liquid being sampled, which are captured by the filter upon expelling the sample from the device.

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Sampling device

The present invention relates to a sampling device, particularly but not solely to a sampling device for carrying out a hygiene test using ATP-bioluminescence.

In systems for dispensing beer or other liquids, it is possible for bacteria or other micro-organisms to accumulate in the conduits through which the liquid is dispensed, despite carrying out periodic cleaning. This has been known for many years to cause quality problems in the brewing industry but no convenient method has been developed to measure the extent of the problem or to overcome it.

We have now devised a sampling device which enables beer or other liquid to be tested for the presence of bacteria or other micro-organisms particularly where such beer or other liquid is delivered through a dispensing system.

In accordance with the present invention, there is provided a sampling device which comprises a plunger longitudinally displaceable in a barrel, the plunger being displaceable in one direction to draw a volume of liquid into the barrel, then being displaceable in the opposite direction to expel the volume of liquid through a filter and also to expel a volume of a reagent through the filter.

It will be appreciated that, if the sample of liquid (e.g. beer) is contaminated with microbial cells, picked up from the dispensing system or otherwise, then these cells will be captured by the filter. Then by passing the reagent through the filter, this will serve to react with the microbial cells so that the presence of such cells may be indicated. The expelled liquid may be collected in a vessel where it is further processed or tested. For example, the reagent may comprise an ATP release reagent, which serves to release ATP from the microbial cells in passing through the filter: the

expelled liquid, collected in the collection vessel, is then mixed with the enzyme luciferase, to react with the ATP and cause luminescence: the vessel may then be inserted into a photometer or luminometer, to measure the degree of
5 luminescence.

Preferably the device is arranged so that the reagent is expelled through the filter only during a final portion of travel of the plunger in the expelling direction. Preferably the reagent is contained in a compartment of the plunger, which
10 is normally sealed by an impermeable membrane arranged to be ruptured at a predetermined point in the plunger's travel. Preferably the barrel is formed with a projection which co-operates with the plunger to rupture the membrane when the plunger reaches the predetermined point in its travel.

15 Preferably the device includes a one-way valve through which the sample of liquid is drawn into the barrel.

Preferably the device includes a nozzle through which the sample of liquid is drawn into the barrel, and through which the liquid is subsequently expelled.

20 Preferably the one-way valve and the filter are provided in respective compartments positioned at the lower end of the barrel. Preferably these compartments are defined between the outer bottom surface of the barrel and a generally disc-shaped member secured to the bottom of the barrel.

25 Preferably the plunger is screw-threadedly engaged to the barrel, such that the plunger is displaced longitudinally of the barrel by turning the plunger relative to the barrel. This arrangement ensures that the longitudinal displacement of the plunger will be gradual, and so minimise the risk of the
30 beer or other liquid foaming as it is drawn into or expelled from the barrel. Preferably the plunger is formed with a helical formation on its outer surface, for co-operating with a projection provided adjacent the upper end of the barrel, to

provide the screw-threaded engagement between the plunger and the barrel.

Also in accordance with the present invention, there is provided a sampling device which comprises a plunger
5 longitudinally displaceable in a barrel by turning the plunger relative to the barrel.

Further in accordance with the present invention, there is provided a sampling device which comprises a plunger longitudinally displaceable in a barrel, the plunger being
10 formed with a compartment which contains a reagent and is arranged to release the reagent when the plunger reaches a predetermined point in its travel relative to the barrel.

Yet further in accordance with the present invention, there is provided a sampling device which comprises a plunger
15 longitudinally displaceable in a barrel, the barrel being provided with a one-way valve for inlet of fluid into the barrel and a filter through which fluid may be expelled from the barrel, the one-way valve and filter being disposed side-by-side at the lower end of the barrel.

20 An embodiment of the present invention will now be described by way of example only and with reference to the accompanying drawings, in which:

FIGURE 1 is a side view of a sampling device in accordance with the present invention;

25 FIGURE 2 is a view of the device in the direction of arrow A shown in Figure 1;

FIGURE 3 is a section through the device on the line III-III shown in Figure 2; and

FIGURE 4 is a section through a cuvette with which the
30 device of Figures 1 to 3 is used.

Referring to the drawings, there is shown a disposable sampling device assembled from components of plastics material. The device comprises a plunger 10 displaceable in a cylindrical

generally cup-shaped barrel 20, from which a nozzle 30 extends. The plunger 10 is hollow and formed with an open upper end 11 of an enlarged diameter: the outer surface of the plunger 10 is formed with a helical rib 12 which co-operates with a projection (not shown) provided on the inner surface of a collar 22 which is ultrasonically welded to the upper end of the barrel 20; the arrangement is such that the plunger 10 may be displaced longitudinally within the barrel 20 by turning the plunger relative to the barrel. An O-ring seal 13 is carried in a peripheral groove formed in the outer surface of the plunger 10, adjacent its lower end, to maintain a seal between the plunger and the barrel as the plunger is displaced.

In the centre of its lower end, the plunger 10 is formed with a cylindrical recess 14, providing a compartment which is filled with an ATP-release reagent and is closed by a foil membrane 15. A projection is formed at the centre of the bottom of the barrel 20, comprising an upstanding tubular section 21 which receives a cap 23 as a push-fit: this projection is arranged to rupture the membrane 15 as the plunger 10 is displaced almost fully into the barrel 20, so releasing the liquid from the compartment 14.

A generally disc-shaped housing member 24 is carried on the outer bottom side of the barrel 20, the member 24 having a rim 25 by which it is ultrasonically welded to the barrel. The member 24 and the bottom surface of the barrel 20 co-operate to define two generally circular, planar compartments 26, 28 respectively housing a flat valve seal 27 and a filter membrane 29. The two compartments 26, 28 each communicate with the interior of the barrel 20 and also with a transverse passage 31 in the top end of the nozzle 30: the passage 31 in turn communicates with a longitudinal passage 32 of the nozzle.

It will be noted that the valve and filter are conveniently positioned side-by-side and formed in a common

structure.

In use, the nozzle 30 of the device is dipped into a volume of beer or other liquid which has been dispensed from a system to be tested. The plunger 10 is then turned by hand 5 in order to displace it longitudinally, in the retracting direction, relative to the barrel 20: a corresponding volume of the beer or other liquid is accordingly drawn through the nozzle 30 and into the barrel 20, via the valve compartment 26.

Next the plunger 10 is displaced in the opposite 10 direction, into the barrel 20, to expel the sample of beer or other liquid from the barrel: the valve 26, 27 is a one-way valve which prevents the liquid being expelled through it, and instead the liquid is expelled through the filter 29. If the sample of liquid includes bacteria cells, these are captured 15 on the filter 29.

Towards the end of the plunger's travel, the foil membrane 15 of its reagent compartment 14 makes contact with the projection 21,23 on the inside bottom of the barrel 20, and is ruptured, so releasing the reagent. During the final travel 20 of the plunger 10, the reagent is expelled, together with the final volume of the beer or other sample liquid, through the nozzle 30 via the filter 29.

In the event of bacteria cells being captured on the filter 29, the reagent which is then passed through the filter 25 serves to release ATP from those cells. The liquid expelled from the device is now mixed with a solution of the enzyme luciferase, in order to promote a reaction with any ATP which has been released, and so cause luminescence. For this purpose, a transparent vessel or cuvette 40 as shown in Figure 30 4 is used: the cuvette 40 includes a cylindrical compartment 42 which is sealed across its top and bottom by foil membranes 41,43, the compartment containing the enzyme solution. Prior to expelling the final volume of sample, and the reagent, from the device, the nozzle 30 of the device is introduced into the

cuvette to pierce and rupture the membranes 41,43: the final volume of sample liquid and the reagent are then expelled from the device and into the cuvette 40, for mixing with the enzyme solution. Then the nozzle of the device is removed from the
5 cuvette and one end of a rod is inserted into the top of the cuvette, as an interference fit: the rod provides a convenient handling means for positioning the cuvette 40 in a luminometer, for the measurement of the photon emission.

It will be appreciated that this device which has been
10 described enables beer or other liquid to be tested on-site in an easy and quick manner, to provide a hygiene test in relation to the delivery system through which the beer or other liquid is dispensed. The device may be used in relation to a wide variety of liquids, including all filterable beverages (e.g.
15 water, soft drinks, juices) and other filterable liquids, where the detection of micro-organisms may be desired, e.g. process, cooling and rinse water in food, beverage, pharmaceutical and industrial processes, or for water in the flower industry (where poor quality water is known to curtail the life of cut
20 flowers). The device which has been described may be used to test for the presence of bacteria or other microbial sources of ATP, including but not limited to yeast, mould, algae and microbial biofilm made up of such organisms embedded in complex carbohydrate structures. However, it will be appreciated that
25 the device may be used with other reagent systems.

Claims

- 1) A sampling device which comprises a plunger longitudinally displaceable in a barrel, the plunger being displaceable in one direction to draw a volume of liquid into
5 the barrel, the plunger then being displaceable in the opposition direction to expel the volume of liquid through a filter and also to expel a volume of a reagent through the filter.
- 2) A sampling device as claimed in claim 1, arranged so
10 that said reagent is expelled through said filter only during a final position of travel of said plunger in said opposite direction.
- 3) A sampling device as claimed in claim 2, in which said reagent is contained in a compartment of said plunger.
- 15 4) A sampling device as claimed in claim 3, in which said compartment is normally sealed by an impermeable membrane arranged to be ruptured at a predetermined point in the travel of said plunger in said opposite direction.
- 5) A sampling device as claimed in claim 4, in which said
20 barrel is formed with a projection which co-operates with said plunger to rupture said membrane when said plunger reaches said predetermined point of travel.
- 6) A sampling device as claimed in any preceding claim, including a one-way valve through which said volume of liquid
25 is drawn into said barrel.
- 7) A sampling device as claimed in claim 6, in which said one-way valve and filter are provided in respective

compartments positioned at a lower end of said barrel.

8) A sampling device as claimed in claim 7, in which said one-way valve and filter compartments are formed between the outer surface of the barrel, at said lower end thereof, and a member secured to said lower end of the barrel.

9) A sampling device as claimed in any preceding claim, further comprising a nozzle through which, in use, said volume of liquid is drawn into said barrel, and through which said volume of liquid is subsequently expelled.

10) A sampling device as claimed in any preceding claim, in which said plunger is screw-threadedly engaged to said barrel, such that said plunger is displaceable longitudinally of said barrel by turning said plunger relative to said barrel.

11) A sampling device as claimed in claim 10, in which said plunger is formed with a helical formation on its outer surface, co-operating with a projection provided adjacent an upper end of said barrel.

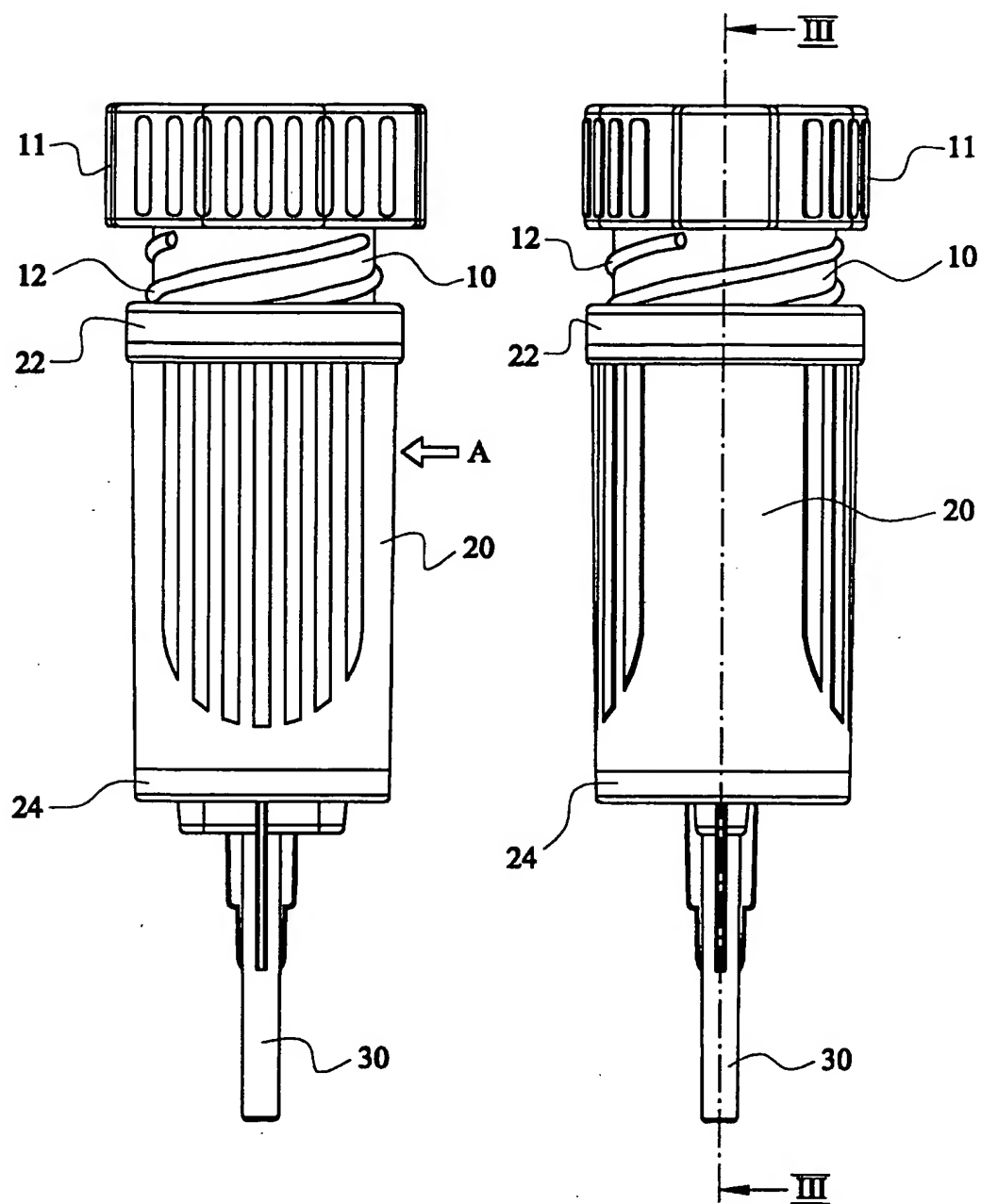
12) A sampling device which comprises a plunger longitudinally displaceable in a barrel by turning said plunger relative to said barrel.

13) A sampling device which comprises a plunger longitudinally displaceable in a barrel, said plunger being formed with a compartment which contains a reagent and is arranged to release said reagent when said plunger reaches a predetermined point in its travel relative to said barrel.

14) A sampling device which comprises a plunger longitudinally displaceable in a barrel, said barrel being

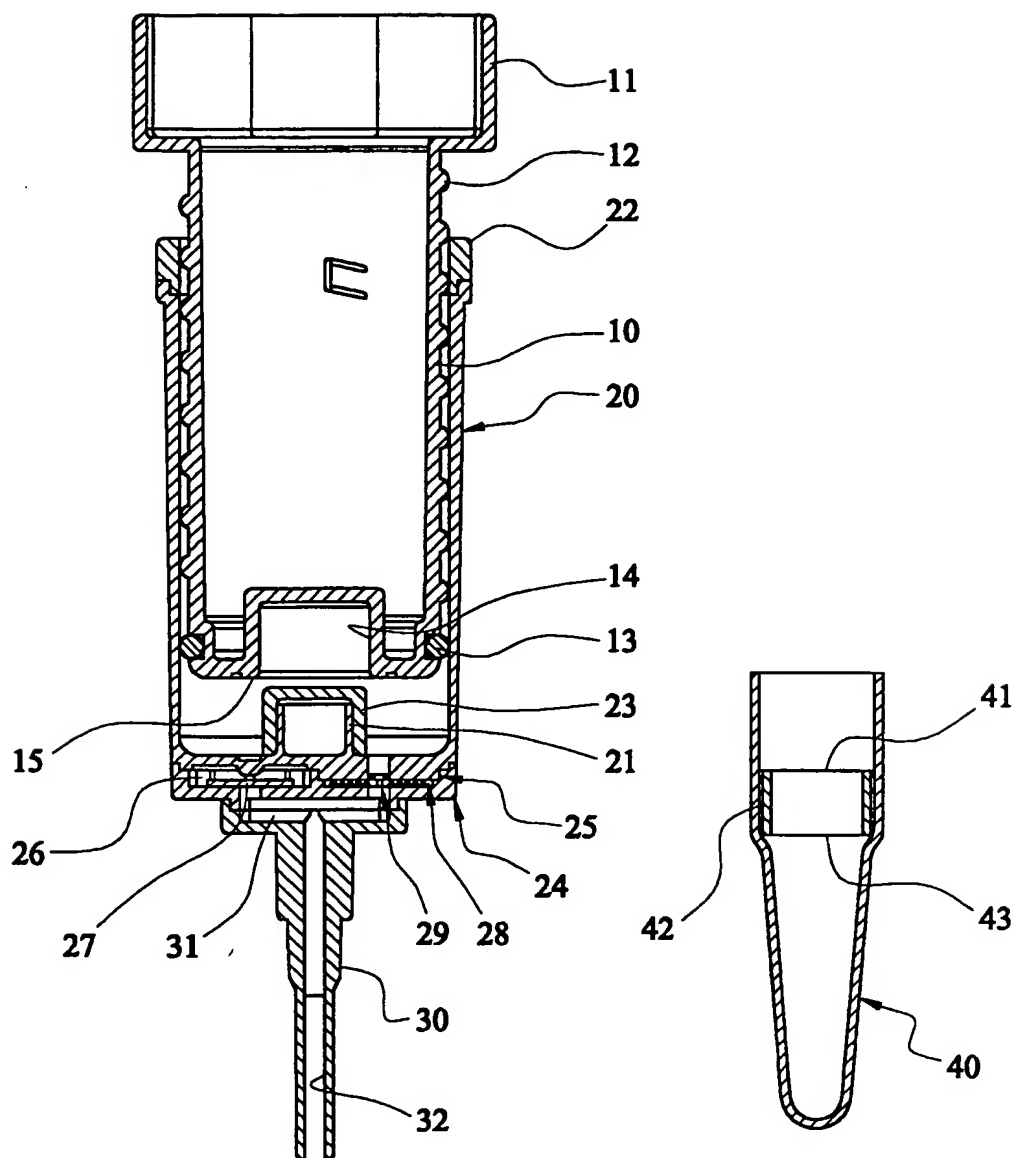
provided with a one-way valve for inlet of fluid into said barrel and a filter through which fluid may be expelled from said barrel, said one-way valve and filter being disposed side-by-side at a lower end of said barrel.

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FIG. 1FIG. 2

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FIG. 3FIG. 4

SUBSTITUTE SHEET (RULE 26)

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A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 GOIN1/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X Further documents are listed in the continuation of box C.

Y Patent family members are listed in annex.

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Date of the actual completion of the international search

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Information on patent family members

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